House Organ

beaufort

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beaufort

Vol. 1, No. 1 - August, 1981

Contents:

Cover Photograph - *Shown on our cover is the 520 foot long drill ship, Canmar Explorer III. The drill tower stands 120 feet high, and the ship has a draught of 22 feet while drilling, and is anchored in place over the drill hole by eight anchors attached to three inch wire rope. The vessel has an ice reinforced double hull for Arctic operations, and can travel at a speed of 13 knots. It departed McKinley Bay on June the 23rd and is presently operating at the Dome/Hunt/Gulf Koakoak 022 well site. Explorer III has a complement of 106 personnel, including the marine crew of 20.*

We would like your views and opinions on the content of Beaufort magazine. Simply drop us a line care of The Editor, Beaufort Magazine, Dome Petroleum Limited,......

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Box 200,
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Beaufort is published by Dome Petroleum Limited to provide the general public, and interested parties, background information on the long range development and production of hydrocarbon fuels from the Beaufort Sea and Mackenzie Delta. In terms of engineering and technical skills production is attainable in this region by the mid-80s. Before approval in principle is obtained from the federal government, a detailed report on the possible effects and impacts of such production must be prepared. This report, known as the Environmental Impact Statement, is to be completed late in the fall of 1981. The E.I.S. will address the issues and concerns raised by the production scenario. BEAUFORT will report on the progress of E.I.S. and the energy industry's evolving plans to address these concerns.

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In Search of Energy Self-sufficiency for Canada

By M.B. Todd,
Vice President, Beaufort Sea Production Operations, Dome Petroleum Limited

With this premier edition of **Beaufort,** Dome Petroleum Limited launches a series of timely and informative magazines about the oil industry's activities and programs in the Beaufort Sea and Mackenzie Delta region of the Canadian Arctic. Our intent with this magazine is to inform the general public and the non-technical reader about the activities that are presently taking place in the Beaufort, and those that will take place as oil and gas discoveries are developed and brought on production. We will address the issues related to current and future activities. We solicit comments from our readers on the articles that appear in our publication, and also invite discussion on issues relevant to Beaufort development.

We are enthusiastic about the energy potential of the Beaufort Sea and about the benefits that development will bring, not only to the people of the north, but to all the people of Canada. We also recognize that there are concerns and fears that our project may cause irrepairable damage to the environment, and have serious negative effects on social and traditional aspects of northern life. We are dedicated to ensuring that the environment will not be damaged and the social impacts will be positive. We hope that this publication will provide a forum to discuss people's concerns and that our understanding of your concerns will influence our design and program for Beaufort development.

Exploration has been taking place in the Beaufort in a demanding landscape, full of financial risk, but also full of promise. To realize the promise that we know is there will require a continued and dedicated effort by both the private and public sectors of Canadian society. It will demand the expenditure of very large sums of money, concerted attention to research and development, and a diligent concern for the cultural and environmental impact that may result. We intend in future editions of **Beaufort** to address both the challenges and the concerns - providing a forum for all aspects of this most vital pursuit.

We believe that the Beaufort region in combination with exploratory ventures off eastern Canada, in the Arctic Islands, and western Canada are the keys to energy self-sufficiency for this country. Estimates place the oil reserves in the Beaufort at 36 billion barrels and the gas reserves at 339 trillion cubic feet, and it is interesting to compare the Beaufort Basin to the equal sized Gulf of Mexico, which has the largest proven oil reserves in the North American offshore. If production does not go ahead in the Beaufort and other exploration regions of Canada, this nation could be importing as much as one million barrels of oil daily by the year 1990. This importation of costly foreign oil, based on a cost of $40 per barrel, will result in a drain on the economy of $14.6 billion dollars annually. On the other hand it is possible to stop that economic drain if domestic production were to proceed in frontier regions such as the Beaufort Sea. Moreover the spending of domestic dollars for those one million barrels of oil could have a rippling, multiplier affect through the Canadian economy, benefiting all sectors of developed industry and diminishing regional economic disparities. A large percentage of this annual benefit would be in the form of revenue taxation to the federal government, not to mention the 150,000 man years of employment that could be created by the development of domestic oil sources such as the Beaufort Sea.

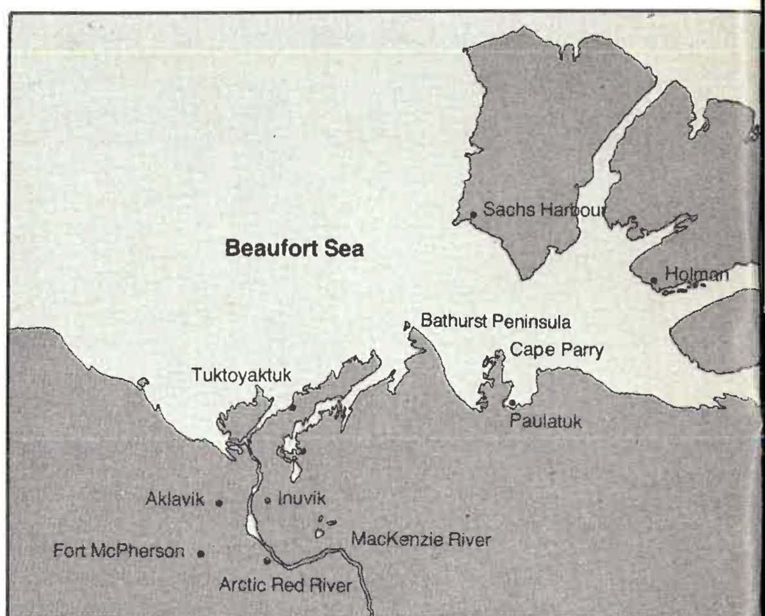
This forecast spin-off of benefits throughout the society would require the expenditure of about $40 billion dollars over the next nine years to launch production and transportation of oil from the Beaufort region. By comparison the oil industry invested approximately $43 billion dollars over 33 years for the exploration and development of oil wells and oil sands in Canada generally. However, not all the costs for production capability can be measured simply in dollars. Canada will have to fabricate 15 to 20 million tons of steel by 1990 in its pursuit for energy self sufficiency. To create a new class of Arctic ships, the Canadian shipbuilding industry will have to cut, weld, and install about five million tons of steel - ten times the amount fabricated between 1970 and 1980 by that industry. To meet the challenges of national oil self-sufficiency will require Canadian shipyards of unprecedented size and capability.

The demand for further research and development will continue as it has in the past. This production scenario will stimulate research and development for a large number of Canadian companies, as it has done for Dome Petroleum and the other oil companies active in the Canadian Arctic. It has been an essential ingredient in meeting the technical problems which have faced our industry in the Arctic. In recent years, our efforts have intensified with a particular focus upon the ice regime of the Beaufort Sea and the Northwest Passage. The total cost for this research and development has been more than $150 million over the past ten years. The environmental research alone by industry and government experts has exceeded $75 million. The solutions derived from this research are a

Continued on page 15

A Scenario for Energy Production

The maps illustrate the location of the Beaufort Sea and Mackenzie Delta in Canada's Arctic.



Back in the late 1950s and early 1960s when the first exploration permits were issued for the MacKenzie Delta and Beaufort Sea, the petroleum industry was faced with many unknowns as they entered that hostile and forbidding region of Canada. Explorers in the 19th Century had commented on the promising geological formations in the Northwest Territories, and an 1888 report said that oil production in the MacKenzie Valley was only a question of time. Following an expenditure of more than one billion dollars, and the drilling of more than 130 exploratory wells by the petroleum industry, that report is coming true. The unknown factors have been answered, and a wealth of experience gained in 16 years. No one knew if you could even drill in the Arctic - it had never been done. There were no drill ships designed for the purpose, and no techniques tailored for the Arctic. The oil industry pioneered a new technology in harsh conditions to confirm what was only a promise.

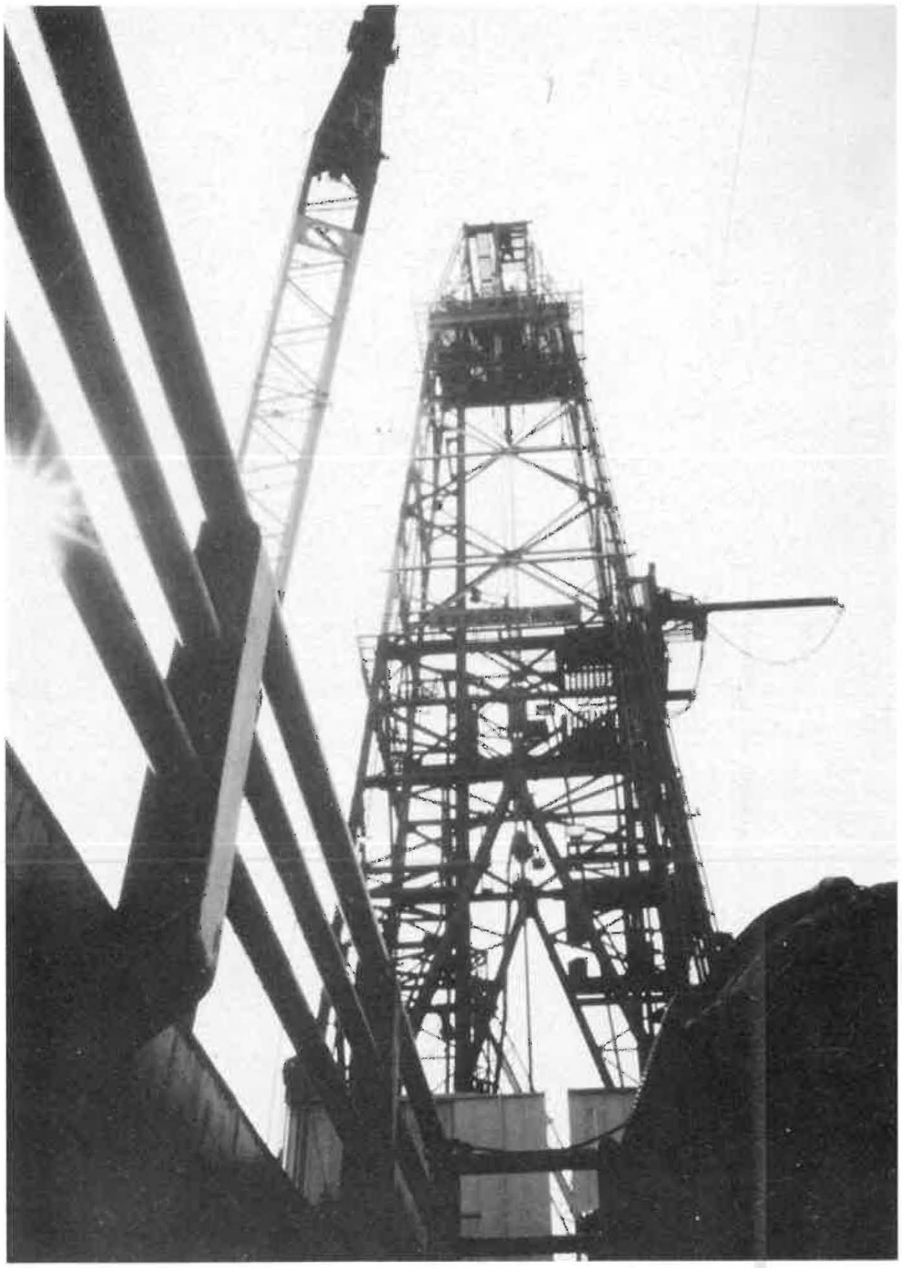
Estimates by the Geological Survey of Canada place the oil reserves for the MacKenzie Delta and Beaufort Sea at about 36 billion barrels and the gas reserves at 339 trillion cubic feet. These estimates are based on more than theory. Despite a short drilling season of approximately four months using drill ships (artificial islands extend this season to year round), virtually all the wells drilled have found oil and/or gas. By contrast over 200 wells were drilled in the North Sea before oil was found. One very promising discovery well in the Beaufort Sea, called Kopanoar, produced a calculated open flow of more than 12,000 barrels of oil daily. Other wells such as Tarsiut, Nektoralik, Ukalerk, and Issungnak, confirm that the significant oil potential in the region is offshore in the Beaufort Sea. But exploration and production schemes face a formidable opponent - sea ice.

To combat that ice has taken years of research coupled with hard, practical experience. The industry has always known that to realize the potential of the MacKenzie Delta and Beaufort Sea it was going to have to develop the technological solutions for year-round exploration and production in icebound waters. Considerable energy has been expended to extend the drilling season, but more importantly, lay the groundwork for production. The major explorers in the region, namely Dome Petroleum Limited, ESSO Resources Canada Limited, and Gulf Canada Resources Inc.,

have designed the equipment and developed the methods to not only find oil and gas, but transport it to market. About $40 billion dollars would have to be expended in this decade applying the technology to create what has been called a "mega-development" of giant oil fields.

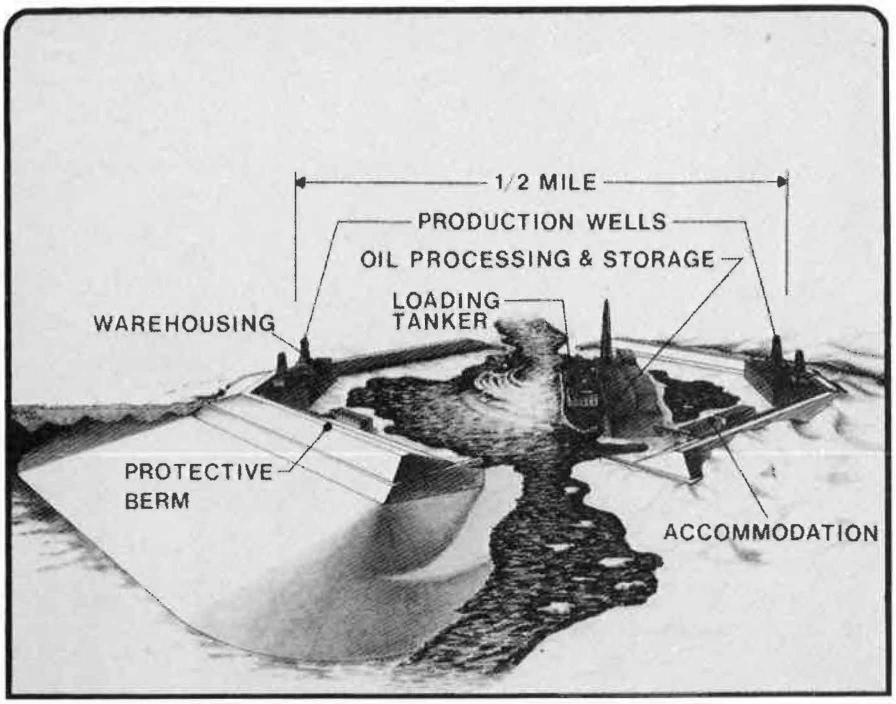
What would the Beaufort and Arctic regions look like after this mega-development? The most likely scenario reveals a closely interlinked network of shore based harbours, offshore Arctic Production and Loading Atolls (APLA), and drilling/production islands, as well as a fleet of oil and perhaps eventually liquefied natural gas tankers that would be the most capable icebreakers ever built. This technology is not out there in the future, it is here and now. The oil companies in the Beaufort have designed the islands and the Arctic ships to make it go. The first artificial island, Immerk, was built by ESSO Resources in 1972 - since then a total of 19 man-made islands have been completed in shallow waters within what is called the "landfast ice zone". One of the newest and deepest islands, Tarsiut, is presently under construction 25 miles offshore of Pelly Island. It is located at the border between the landfast zone and the seasonal icepack in 70 feet of water. It is being designed to withstand winter ice six feet thick, and survive the forces of pack ice, and ice islands on the move.

Tarsiut is a prototype for future islands and is also a research laboratory fitted with more than a million dollars of instrumentation to assess ice loads, seismic activity, seabed permafrost disturbances, and the stability of the island foundation. Television and radar will be employed to study the characteristics of the ice which will surround Tarsiut. The island will be used for exploratory drilling, but should that drilling prove successful, it could be enlarged and further strengthened into a full scale production island at a later date. A production island must last between 15 and 25 years, compared to two or three years for islands such as Tarsiut.



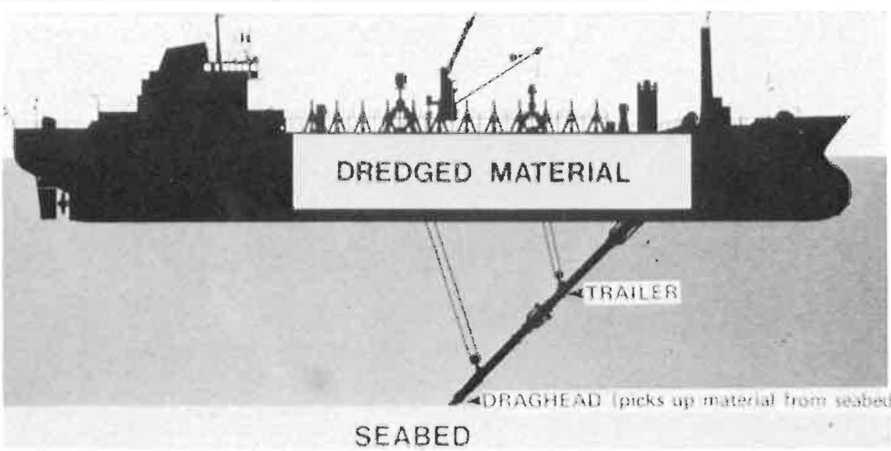
The derrick of the Explorer III ship stands 120 feet high, and is capable of drilling down 25,000 feet through 600 feet of water.

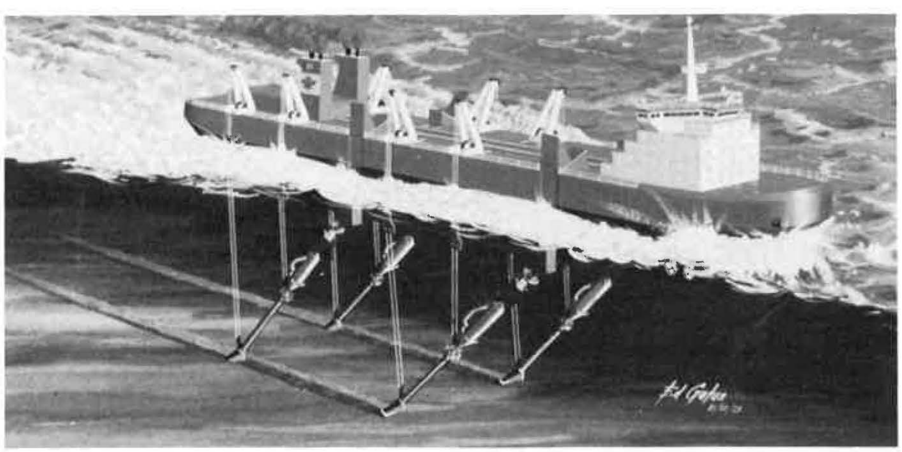
Using similar techniques to those developed for exploratory platforms, the industry is capable of moving out into still deeper waters with the large production platforms. What would be necessary for full scale production is a central terminal for oil processing, storage, docking and handling, as well as ship transfer. Dome Petroleum calls this terminal an Arctic Production and Loading Atoll (APLA) because it would look like a coral atoll, being ring shaped. It could have two entrances, and will allow tankers to dock and maneuver in a completely protected area. To build an APLA could require as much as 120 million cubic metres of sand, compared with the approximately 50 million cubic metres needed for a deep production island. The Atoll would be capable of accommodating up to four drilling rigs. Pipelines laid beneath the ocean



Arctic production and loading ATOLL (APLA)

These artist's renderings illustrate the plan view of a conventional dredger, and Dome's newest Superdredge which will be capable of moving about 11 million cubic metres of fill per year.





floor would draw in oil from other production islands to the APLA.

Designing the production platforms and terminals must go hand in hand with the ships to support them. The oil industry has become a leader in the design, construction and operation of a wide variety of specialized marine vessels, and the use of dredgers and icebreaking ships in the Arctic environment. One type of dredge used (a suction hopper dredge), otherwise described as a nautical dump truck, is capable of sucking up large volumes of sand from the ocean floor and hauling it to a different site for island building. Dome Petroleum has designed a "Superdredge". It will be able to suck up and store inside its hull 25,000 cubic metres of sand, more than twice the volume of any previous design. This Superdredge could be built as early as 1983, and when completed would meet at least Class Six icebreaking standards. It will be able to dredge material from the sea bottom, all year round, to depths of 250 feet.

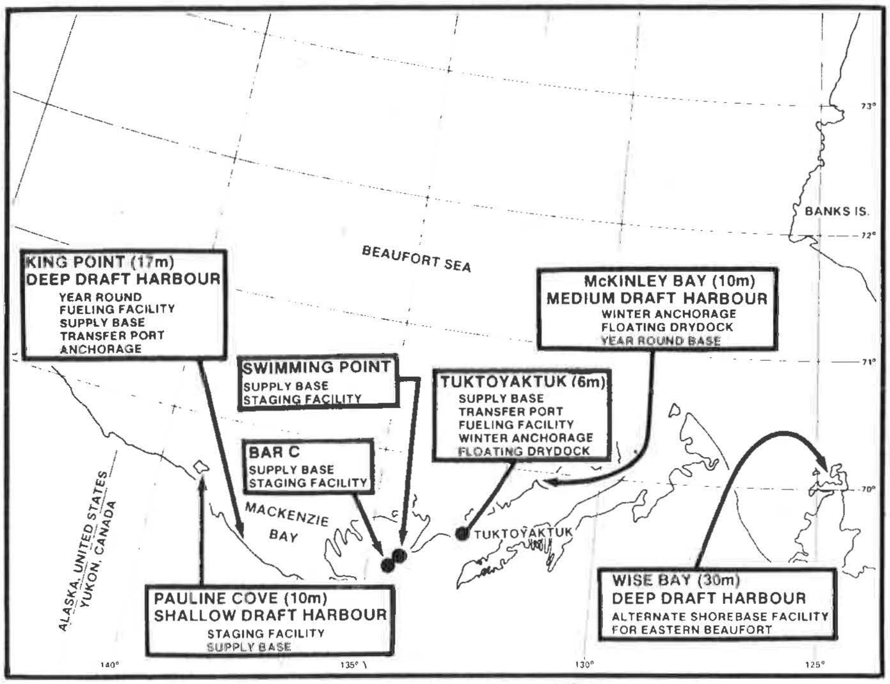
Dome has already put in service an advanced icebreaker of its own design, named the Kigoriak. This experimental ship has tested many of the features considered for use in future Arctic class ships, especially oil tankers. The hull form is particularly radical for icebreakers, in that it is basically straight-sided with a spoon shaped bow to break thick ice with a minimum of energy expenditure. To increase the ship's maneuverability and reduce friction along the straight hull, the bow is equipped with a 'reamer' and the hull is undercut at the stem. The reamer serves to break the ice at least six feet wider than the hull. This, combined with the bevelled sides at the stern has helped greatly in turning the vessel. Other prototype features incorporated into the Kigoriak include a water spray system for reducing friction along the bow, the use of a large, deep mounted propeller protected from ice by a nozzle, and the placement of fuel oil containers away from the outside hull much as they will be in Arctic tankers.

Experiences gained with the

Kigoriak are reflected in the new Supplier 9, the design of the Superdredge, and the AMLX-10 icebreaker expected to arrive in 1983. Together they provide the proving ground for the future generation of safe Arctic tankers. These 200,000 dead-weight ton ships will be more than 1000 feet long, double hulled, and will carry about 1,500,000 barrels of oil per trip inside centrally located, reinforced compartments. These ships will have a Class 10 rating, which will allow them to break through level ice up to 10 feet thick with little difficulty. Aside from the exceptional design considerations, which will result in the strongest and safest tankers ever built, they will be guided through their shipping routes by a highly sophisticated navigation system referred to as "REMSCAN". This acronymn refers to the remote sensing communications and navigation system which would be used to assist with navigation. Information on ice, weather, and other important factors will be fed into an onboard processing centre from satellites, aircraft, or from shipboard radar. All this data can be used to ensure that the ships travel the safest possible route each time they transit the Northwest Passage.

The alternative scenario to transfer oil from the Beaufort region is via a pipeline from a northern terminus possibly located at Richards Island and running south to Edmonton, Alberta. Such a pipeline would be 1400 miles long. Based on the most plausible technical forecast it would be about 42 inches in diameter, have 24 pumping stations approximately 58 miles apart, and when operating at a maximum pressure of 1000 psi could handle about 1,415,000 barrels of oil a day. In the early years of production such a pipeline would demand only four pumping stations, each one capable of generating 28,000 horsepower. Where technical and environmental considerations make it feasible the pipeline would run underground, but some sections would be elevated on vertical steel supports, insulated, covered in turn by a steel jacket. River and stream

Possible shore bases and navigation routes are illustrated on these maps, and are part of the 1985 - 2000 production scenario for oil production.



NOTE:
Other shore areas are expected to be required for pumping stations, processing plants, and pipeline right of ways.

Functions of harbours and shorebases in support of Beaufort Sea - Mackenzie Delta Operations - 1980 - 2000.

TANKER ROUTES

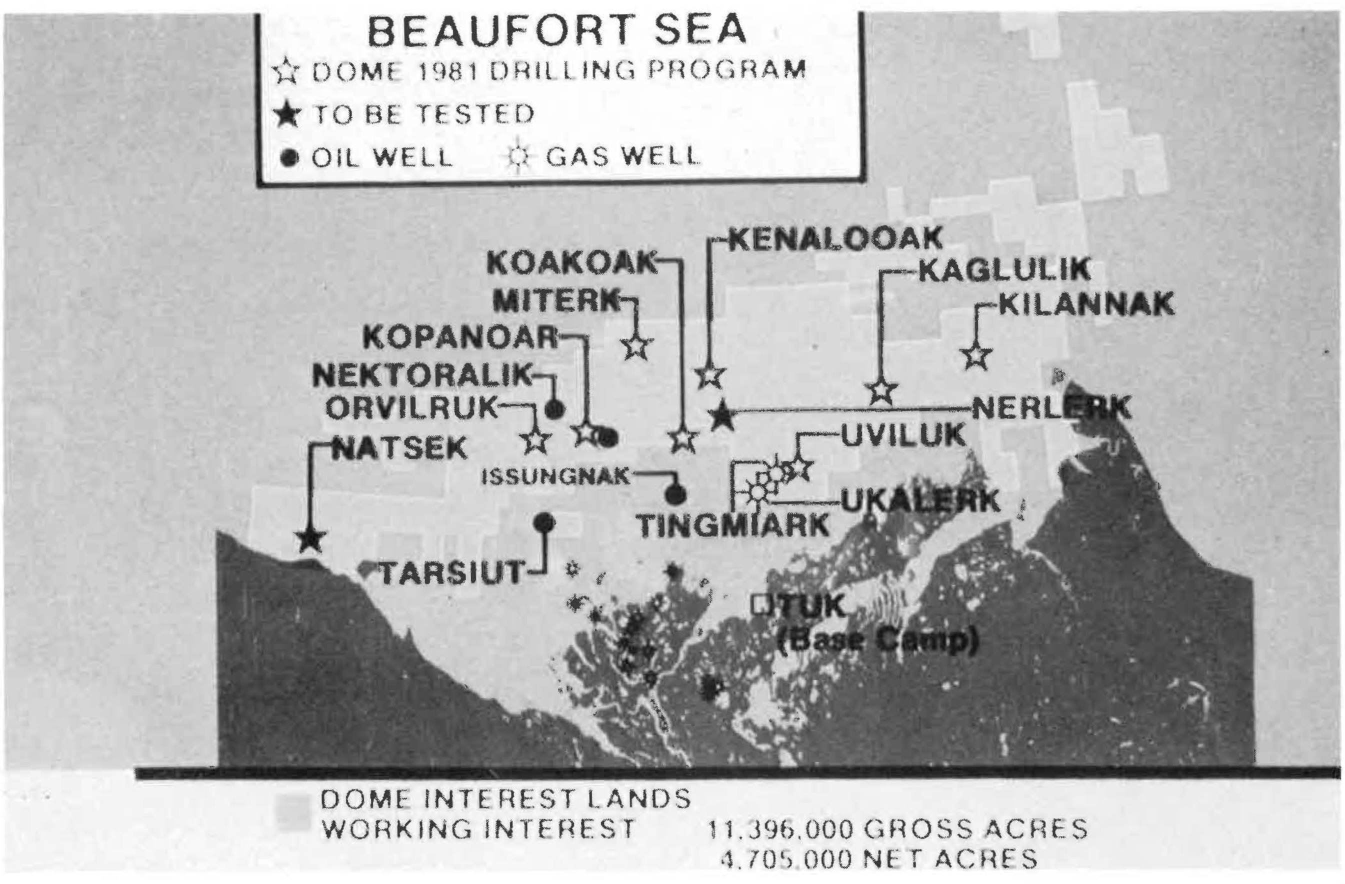
crossings would be handled in accordance with established government and industry procedures.

Whether pipelines, icebreaking tankers, or both are utilized to transport oil and gas, shorebases and harbours will be necessary to handle personnel and material and to act as staging areas for equipment brought in to build and service these offshore facilities. Tuktoyaktuk is the major support base for offshore operations today, and would continue mainly as a shallow draft harbour, seasonal supply base, and as a year-round field office. In the Beaufort area there are only a limited number of possible harbours and staging points available; among them are Mckinley Bay as a medium draft, year-round harbour supporting a shore base, King Point as a year-round deep draft harbour, and Wise Bay which could be a deep draft harbour and an alternate shore base facility in the eastern region of the Beaufort. Offshore oil brought to land by a subsea pipeline would be directed to storage and processing facilities possibly at Richards Island.

What timetable might be followed in applying all the technical features described? Well, in the 1981 to 1985 timeframe, the pre-production phase, approximately 35 offshore exploration and delineation wells could be drilled, as many as one third of these from artificial islands, the rest from conventional drillships and advanced systems. Up to five deep water exploration islands, each requiring as much as four million cubic metres of foundation material, and a larger number of shallow water islands would be constructed in this time frame. Dependent upon the option chosen - i.e. tanker transport or pipeline transfer - construction would be initiated in this period on one or the other.

Projecting our scenario out into the 1986 to 1991 timeframe best estimates suggest that about 60 ex-

Dome's 1981 drilling program and previous discoveries are illustrated here as well as ESSO Resources Issungnak.

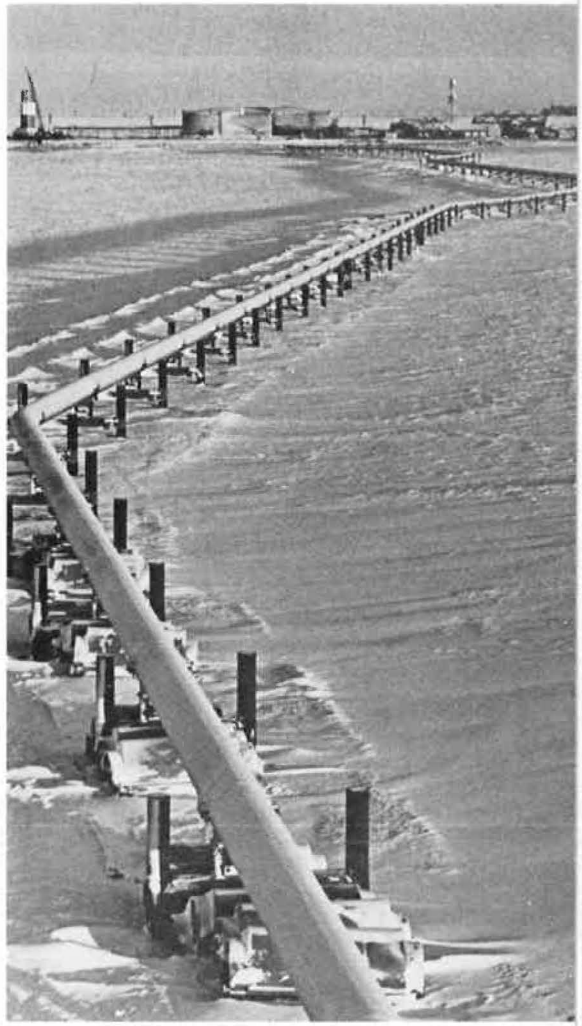


ploration and delineation wells would be drilled, at least 10 from artificial islands. In addition about four production islands would be envisaged in shallow waters, plus one deep water artificial island demanding up to 50 million cubic metres of dredged material. One APLA (Arctic Production and Loading Atoll) would be built and approximately 160 offshore production wells drilled. Assuming that the pipeline transfer option goes ahead, it would be necessary to construct subsea pipelines that would link the second offshore oil field with the landbased tank farm. In this same timeframe, given that the MacKenzie Valley pipeline would be completed, production rates would rise to an estimated 500,000 barrels of oil a day. Taking the alternate scenario of tanker transport, it is forecast that 11 tankers would be built to transport the oil to marketplace.

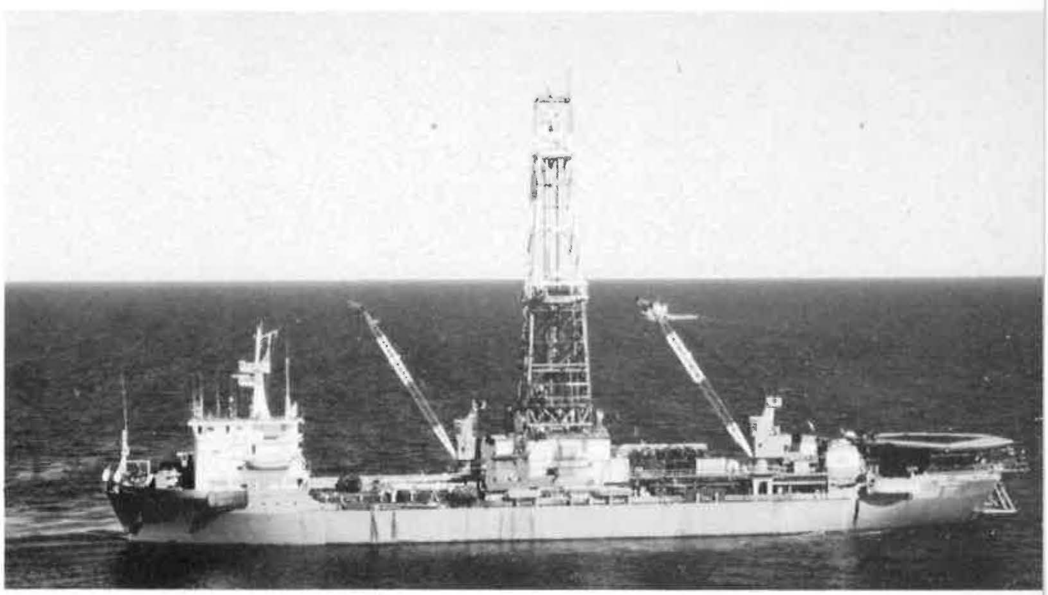
Naturally, as we, extend our forecasts past 1991 into the turn of the century they become more speculative and less defined. Therefore estimates of numbers and sketches of the production scenario are tentative, based on our best technical insight at this time. We project that at least 90 to 100 more exploration and delineation wells would be drilled, many of them from artificial islands. At least eight production islands could be built in shallow water, and one or more deep water islands as well. Given a tanker scenario two more production APLAs would be completed and approximately 400 production wells drilled. A tanker scenario moving out to the year 2000 would require 15 additional tankers, bringing the total fleet to 26 ships. On the other hand, assuming the existance of the Mackenzie Valley pipeline, more subsea pipelines would be laid connnecting the offshore resources to landbased facilities. It is envisaged that up to 1,250,000 barrels of oil could be produced daily by this time period.

The transportation of gas will depend primarily upon market demand. Based on current North American gas markets, full scale gas production is unlikely before 1992. Assuming gas is marketed during this time frame there could be between two and five offshore producing gas fields interconnected by a subsea pipeline gathering system which would be separate from the network for oil. The gas could be transported onshore to the proposed Dempster Lateral pipeline, or somewhat less likely, it could be transported by Liquefied Natural Gas (LNG) tankers. Six of these vessels, assuming a 1992 timeframe, would be built initially with as many as 16 operating by the year 2000. Another option for future gas production would be a combination of pipeline and LNG tankers.

All this preceding narrative represents a plausible and technically sound forecast of what may take place up to the year 2000. Naturally, reducing possible negative impacts is a vital ingredient of any development scenario, and the scenario may well be changed or evolved to take account of important socio-economic and environmental factors. The final combination will be a melding of technology, commerce, environment, and social needs in order to create a communal infrastructure that is beneficial for the northern region and Canada as a whole.



This photo illustrates the start of the Prudhoe Bay, Alaska pipeline.



Dome's Canmar Explorer III sailing in the open summer waters of the Beaufort Sea.

Major Concerns of Beaufort Sea Production

Oil and gas production and transportation in the Canadian Arctic presents a variety of significant technical challenges. Coupled with these challenges are a number of environmental concerns which the industry has been aware of, as well as dealing with during its years of exploration. Many of the answers to technical problems have gone hand in hand with environmental and socio-economic solutions. Most of these solutions have been developed through the course of lengthy and diligent research, structured and cautious development, and the sensible application of real world experience. The oil industry's expertise, built up over more than 15 years, has given it invaluable insight into both the technical and environmental concerns. A sensible

approach to these concerns is reflected in the excellent safety record achieved in the Beaufort Sea and Mackenzie Delta. There have been few serious mistakes, no well blowouts, and little ecological damage caused by exploration.

Thanks in part to the oil industry's experience in the Arctic, it is acutely aware of the sometimes delicate balance between climate, geography, and nature. The concerns expressed by the lay public and ecologists alike are shared by the industry. Since some of the interactions between living things in the Delta and the Beaufort Sea may be disrupted by exploration and development, the industry has been especially cautious in applying new technology to the region.

Frequently small scale ex-

This is the Ibyuk Pingo two miles from Tuktoyaktuk. It is a unique formation 45 metres high caused by the freezing of ice below the tundra surface.

Ice research parties study the natural leads, or breaks, in the sea ice, as shown in this photograph, to learn more on their location and characteristics.

perimental models are constructed and tested by the industry before any full scale development is undertaken. For example, model islands were built first to test the impact of ice on their structures, and thereby establish safety criteria in the real world. The Kigoriak Class Four icebreaker is a fore-runner of a wholly new class of 200,000 dead weight ton vessels which, when constructed, will be the safest tankers in the world.

The possible influence of year-round icebreaking through the Northwest Passage, and the building of artificial islands in coastal waters, has been examined through ongoing research and development programs. The experimental program with the John A. MacDonald icebreaker, the ongoing Kigoriak research program, the comprehensive ice tank testing, plus the cumulative experience acquired by operating in the Arctic environment year after year, in all seasons, are providing a backlog of data

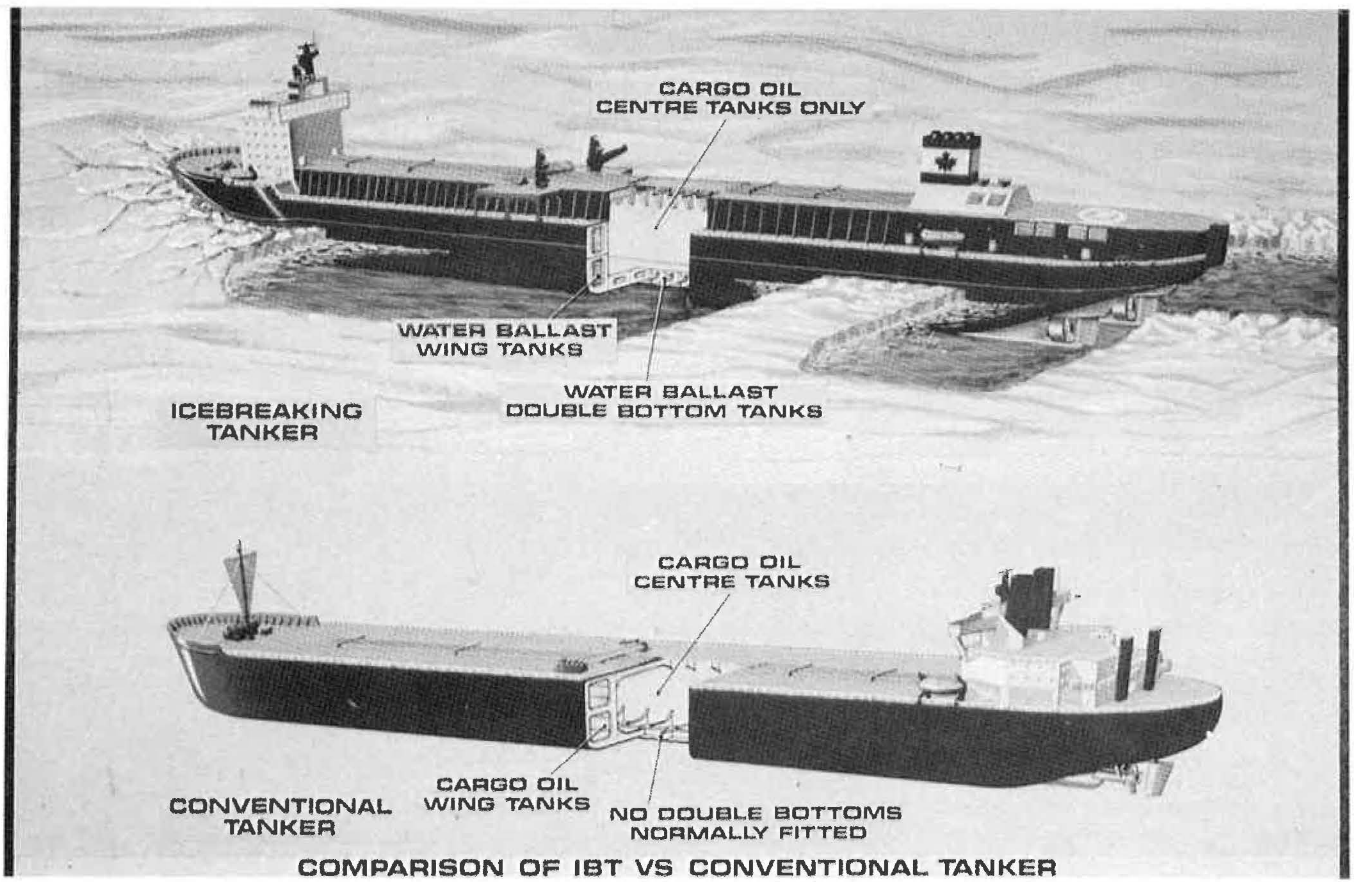
Trained divers are used to conduct sub-sea environmental sampling of organisms which live below the ice, and which are vital in the Arctic food chain. Divers also conduct research on the dispersion of oil spills below the ice surface.

which reveals that environmentally acceptable solutions are available. Double hulled tankers, built to stringent standards, are designed to survive collisions with heavy ice. Even in the remote event of hull puncture, safety features incorporated into the oil tanks should prevent any significant spills or leakage. The projected design of these new generation tankers includes a longitudinal beam strength ten times that of present day, conventional tankers, as well as other safety features such as two independent steering and propulsion systems. Moreover safety systems on board the tanker would allow the removal and relocation of oil should a tanker ever be grounded, in addition to deballast capability to refloat the ship.

Industry and government agencies have conducted research on the impact of tanker traffic upon ice and the sea life that make their home on, or under that ice. For example, there have been noise studies conducted with Kigoriak to determine the impact, if any, of tanker passage on animal life, their habitats, and migration patterns. Tanker routes can be selected which avoid ecologically vulnerable areas. Shipping corridors will be surveyed to obtain adequate bathymetric and sea ice data, and a preliminary study has been completed on hunters' travel routes across the ice.

One of Dome's nine supply vessels is shown working in icy waters near the drill ship.

Research and development has been conducted on a variety of other technical issues relevant to environmental protection matters and solutions are evolving to handle them. The subjects addressed have been diverse, but have included the assessment of methods to prevent oil spills, or clean them up should they occur, artifical island construction and dredging operations, and the installation and operation of safe sub-sea well control systems,



This artist's rendering illustrates some of the design difference between a conventional tanker and those being considered for year round Arctic operations.

pipelines and other submarine hardware.

We have obtained valuable information on the behaviour of oil under and in sea ice, and ways and means for cleaning up the oil. A study conducted in 1980 on the spread of oil under ice showed that up to 80 percent of the oil could be removed with the remaining 20 percent dispersing naturally with negligible impact on the environment.

Surprisingly, ice has proven to be more of an ally than a foe when it comes to restraining and cleaning up oil spills. What we have found is that ice edges form natural booms to collect oil against, and in the case of shorefast ice, which is generally the last to leave the Beaufort region, it protects the important foreshore coastline. During the lengthy winter period ice continues to grow and encapsulates oil, keeping it away from contact with the marine mammals and other biota. During this process of "cold storage" ample time is available for trained people to plan an effective clean up strategy, to transport and set up equipment, and to handle the oil once it begins to be liberated from the ice in the spring. The freezing of the oil during the winter months preserves its most volatile components, which helps tremendously with burning during the spring. Although industry and government work in this important area continues, the statement "ice is nice" is becoming quite appropriate in the field of Arctic oil spill cleanup research.

Artificial islands constructed in the offshore Beaufort must be safe and able to withstand ice forces within the realm of probabilities. Experience gained in the construction of shallow water islands, and new innovative technologies are being applied in the construction of the latest island, Tarsiut. Methods are being developed and tested to increase the slope of the subsea mound used as the base for mounting the large retaining walls. Increasing the slope means less material will be required, which will, of course, reduce the extremely expensive construction costs. However, it will also result in reduced habitat alterations, both at the dredge sites and in the vicinity of the island. The retaining walls, or caissons, will further reduce material required, and are also being designed to be portable and reusable. The multi-million dollar research program intended to investigate factors such as ice, erosion, and earthquake forces and their possible influence on the integrity of the island, as well as numerous other programs, will play a very important role in the design of safe future production platforms in the Beaufort region.

The sub-surface well heads, manifolds, and control systems employed on the ocean floor have been designed with safety and stability as paramount ingredients. They have to function flawlessly in cold waters, be maintainable under the oceans, and be protected from moving ice. Drillships are equipped with rapid disconnecting systems which permit a shut down of exploratory drilling operations, thereby minimizing the risk of a blowout. This rapid disconnect is necessary should severe ice conditions move into the drilling area.

Further research is being conducted on the laying of sub-sea pipelines on the seafloor in areas of ice scouring. We have concluded that should pipelines be laid to shore, they will be buried beneath the depth of maximum probable ice scouring in areas where this occurs.

Any development scenario for the Beaufort Sea and Mackenzie Delta demands close attention to social and economic influences. The oil industry has worked closely with northern communities during the years of exploration. This rapport will be fostered and promoted in the years ahead. The concerns related to community growth, education, cultural and employment opportunities, must be handled by a continual process of communication and liaison, so that future developments are prepared for in an orderly fashion, building upon past experience. In this way the positive benefits are maximized.

Naturally, the technical scenario, whether we discuss pipelines, tankers, man-made islands, or some combination thereof, may result in different environmental impacts. Therefore any forecast for development must include a variety of options. Research and development will help point the way for those optional choices, but undoubtedly the scenario will change as we learn more about the environmental and social impact. After all, this is an unfolding drama, evolving and improving as it goes.

Reindeer herding operations are conducted by northerners, and the animals are harvested annually and the meat and byproducts sold.

Profile: Environmental Assessment Panel

The Environmental Assessment Panel has been created to review all the diverse aspects of oil and gas production in the Beaufort Sea, including social, technical and ecological ingredients. Because this panel has such a broad mandate, its 7 members have been chosen from notably diverse occupations and with an encompassing range of expertise. Environment Canada, the federal ministry responsible for appointing the panel, staffed it with both generalists and specialists, with academics and especially with residents of Canada's northern regions. It was no easy task to meet all the criteria for board membership, since it was particularly important that the board not be composed of either industrial advocates or government bureaucrats, each with their vested interests. It was also very important that those people most directly impacted by oil and gas development, the northern residents, would be an integral part of the review process and assessment.

This amalgam of characteristics has been achieved when we examine the board members.

The chairman of the Environmental Assessment Panel is Dr. John Tener, a Ph.D. graduate of the University of British Columbia in vertebrate ecology, who has had a long and illustrious career in wildlife studies, particularly northern species. He worked for the Canadian Wildlife Services from 1949 to 1973, conducting research upon the musk-ox and other Arctic animals. In 1973 he was appointed assistant deputy minister of the Environmental Management Service of Environment Canada, and from 1977 to 1979 he held the senior post as executive director of the Arctic Institute of North America at the University of Calgary. Since then Dr. Tener has been a special advisor in the Department of the Environment.

Dr. Ross MacKay is a professor of geography at the University of British Columbia, and an internationally recognized expert on postglacial history of the Canadian Arctic's western coasts. He has

spent more than 25 seasons on that Arctic coastline, conducting research on permafrost, pingos, and various ice formations. Dr. MacKay has served on a variety of national and international committees in the past, and has received several awards for his work.

Mr. Douglas Craig is a retired engineer living in Carbon, Alberta who most recently held the position of vice-chairman of the Energy Resources Board of Alberta, from 1971 to 1977. He has a thorough and complete understanding of the oil and gas industry in this country, through his long affiliation with the Oil and Gas Conservation Board, the predecessor to the Energy Resources Conservation Board.

The remaining members of the Environmental Assessment Panel are northern residents, in varied occupations.

Mr. Lucasi Ivvalu, of Igloolik, Northwest Territories, was born and raised in the eastern Arctic and has an intimate knowledge of that region and its people. From 1973 to 1977 he was the Settlement Secretary at the hamlet of Igloolik, and from 1976 to 1978 the Secretary Manager of the community. In 1978 he was appointed the speaker of the Baffin Regional Council and opened the March, 1979 session of the Council.

Mr. Allan Lueck, a lawyer from Whitehorse, Yukon Territory, has been involved in the mining exploration and development of the Yukon. He helped create the Yukon Native Brotherhood as well as the Council for Yukon Indians. From 1969 to 1977 he was legal advisor to the Council and was on the Council's land claims negotiating team from 1974 to 1977. Mr. Lueck has also been a director of Whitehorse Coppermines Ltd.

Mr. Fred Carmichael, of Inuvik, Northwest Territories, is a commercial pilot who has worked in the region all his life. From 1961 to 1976 he operated Reindeer Air Services at Inuvik, and in 1978 joined Kenn Borek Air as a pilot. He brings to the panel an intimate understanding of the people and regions affected by the proposed development.

Mr. Michael Stutter has lived for many years in the Yukon Territories, and is a member of the Territorial water board. He was a member of the Territorial Council from 1970 to 1974, and has been involved in gold mining around Dawson City since 1971. For many years Mr. Stutter operated a river barge service to Old Crow, one of the Yukon communities near the Beaufort Sea. He brings to the Panel a thorough knowledge of the Yukon region and its people.

In Search of Energy Self Sufficiency

Continued from page 3

combination of strength and sophistication - for example, Class 10 icebreaking hulls that are virtually indestructable coupled with a pinpoint navigation system electronically linked to orbiting satellites. Both stength and sophistication are demanded to feed a fuel hungry Canada.

Technical know-how and the excitement of the challenge are only one part of the impetus towards Canadian energy self-sufficiency. Recent events in the Middle East, such as the war between Iraq and Iran, have highlighted how tenuous a nation's hold can be on autonomy. Relying on unstable foreign sources of oil is not comforting, but in Canada's case this insecurity can be overcome. We as a nation have the potential to be self-sufficient in oil and we can attain this goal by the end of the century. The Beaufort Sea frontier is one of the keys to that autonomy and security.

Notice To The Northern Communities

TRANSLATION

To ensure that the premier edition of Beaufort is available to the northern communities during the Environmental Assessment and Review Panel's community meetings this summer and fall, we have printed it in English only. All subsequent editions of the magazine will be translated into Inuktiut and the language of the Western Arctic, and can be obtained by writing to.....

The Editor
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The Participants in the Environmental Review

Before any major developments can take place in the Beaufort Sea, a lengthy and thorough public review must be conducted The results of the review will provide guidance as to the nature and magnitude of developments to be employed, and the timing of such development.

The environmental and socio-economic approval will come from the federal government, following the report of the Environmental Assessment Panel - this approval may be granted in about two years but in the meantime the Environmental Assessment and Review Process (EARP) has been launched by the appointment of a panel. Let's take a look at who will be involved in the process, and then how it is to progress.

A look at the assessment and review process which will lead to a regional clearance to approval in Principle.

Firstly we have what are called "the proponents". In the case of the Beaufort Sea and Mackenzie Delta scenario, they are the oil companies, more than 40 of them in all. However, the largest operators in that region are Dome Petroleum, Esso Resources, and Gulf Canada. In essence these three are the leaders of a consortium who wish to see production go ahead in the Beaufort. Secondly, there are the government "initiators" also called the "sponsors". In this case, the Department of Indian and Northern Affairs (DINA), is the sponsor. In July, 1980, Beaufort Sea - Mackenzie Delta Development was referred by DINA to the Department of Environments FEARO office (Federal Environment Assessment Review Office). This office, which was established in 1973 was set up to determine in advance the potential environment impact of all federal projects, programs, and activities. When the government is concerned that a project may have significant environmental impact, at many difference levels, it appoints an Environmental Assessment Panel. All EAPs are independent bodies that report their findings directly to the Minister of the Environment. Each panel has an attached Executive Secretary with a staff to assist the panel.

Historically, requests by proponents have related to "project specific" developments, such as the Norman Wells development and the Arctic Pilot Project to transport liquefied natural gas. In fact, the government appoints panels in all industry sectors to examine the impact of particular projects. But this Beaufort Sea Environmental Assessment and Review Process has a much broader mandate and series of goals.

This panel has been asked to evaluate on a broad regional basis the impacts which may be associated with development in the Beaufort region and subsidearies impacts which may be felt by other areas of the Arctic.

Part of the mandate of an Environmental Assessment and Review Panel, particularly the one appointed to examine the Beaufort scenario, is to provide detailed instructions or "guidelines" to the proponents, i.e. the oil companies, on what information is necessary. The guidelines alone are a 47 page long document. From those guidelines will eventually be produced the Environmental Impact Statement (EIS) mentioned earlier. But the guidelines are a draft, subject to discussion and possible change by the proponents and the initiators, as well as a variety of interested parties who can participate in this assessment and

The village of Tuktoyaktuk.

review, via a series of public meetings.

Besides the federal agencies already mentioned and the oil companies, there are a variety of other 'actors' or participants. There is the Department of Indian and Northern Affairs, who was in fact the prime initiator for this Beaufort Sea and Mackenzie Delta scenario, by requesting in July of 1980 that FEARO look at the development program. There are the northern community associations whose interests are most directly affected by the oil and gas production plan, and there are environmental protection interest groups concerned about ecology. All these interested parties have been invited to involve themselves in the assessment and review phase.

Helicopters are an important transportation mode between shorebases and the drill ships.

A Timetable For The Environmental Review

The initial stages of this environmental assessment and review process go back to mid 1980, but the appointment of a panel in February of 1981 by the Minister of the Environment, the Honourable John Roberts, heralded the start of work in earnest on the review. On June 12th, 1981 the panel released the first draft E.I.S. (Environmental Impact Statement) Guidelines. This took place, appropriately, during the opening of the Beaufort Sea Panel's office in Inuvik, Northwest Territories. This 47 page book has been condensed into an 11 page summary for the general public, and particularly the northern communities. It was released in June as well, and is translated into Inuktitut and the language of the western Arctic, for use by native communities.

What takes place now is a series of meetings late this summer and in the fall to obtain feedback on the draft guidelines - feedback from the proponents and all other interested parties and individuals. Members of the Panel Secretariat will be visiting all communities in the north that may be affected by the Beaufort Sea oil and gas production and transportation. The visits will enable the community leaders to talk with the secretariat about the whole review process, plus the guidelines themselves. The Panel itself will conduct public meetings between the end of August and September, of two kinds. Firstly there will be general sessions open to anyone wishing to make a presentation of either a technical or non-technical nature. They are expected to be held in Calgary, Yellowknife, Whitehorse, Inuvik, Pangnirtung, and Pond Inlet. Specific subject sessions related to the issues of most concern in a particular geographic region will be scheduled at each of these communities.

Secondly there will be community sessions, limited to hearing presentations from community members. The Panel is planning to hold community sessions at Tuktoyaktuk, Inuvik, Pangnirtung, Pond Inlet, and Fort Good Hope. Prior to either set of public meetings the Environmental Assessment Panel will release a set of Operational Procedures, outlining the details of how the public meetings to discuss the draft Guidelines will be conducted. However, the Terms of Reference for the Panel have already been released and are available to interested parties.

Following this set of meetings, a final draft of the Guidelines should be released sometime before Christmas. The proponents, Dome-Esso-Gulf et al, will submit their Environmental Impact Statement based on this final draft. This EIS will be distributed to interested northern communities for study. Then in 1982 the Panel will return to each of the communities for further meetings. The communities and individuals will be asked if the EIS answers fully the questions and concerns posed in the Guidelines.

Subsequent to this phase the EAP will write its report to the federal government. The government will then make the final decision as to what Dome-Esso-Gulf can or cannot do and under what conditions, in the Beaufort Sea and Mackenzie Delta region.

For those interested parties who will be unable to attend the community or public meetings, the Federal Environmental Assessment and Review Office encourages them to submit their observations in a written form, prior to August 10th, 1981 so that copies may be distributed to all participants prior to the public meetings. The Beaufort Sea Panel Secretariat is headed by ***Mr. David Marshall, at 700, 789 West Pender Street, Vancouver, British Columbia V6C 1H2.*** That office can provide individuals with the background information they may need, or if they would prefer to make a phone call to obtain information, the Secretariat's Vancouver office number is (604) 666-2431.

Sea Ice in the Beaufort

One tends to think of ice as, well, simply ice. Its the stuff that floats in your Kool Aid or gin and tonic, coats your car window in the winter months, or covers the Arctic Sea. In the form of ice bergs it has been known to sink ships, and most of us know that the bulk of an iceberg lies below the surface of the water. In our mind's eye we conjure up an Arctic Sea of endless, seamless white stuff, stretching to the far horizon, sitting placidly for summer thaw. The truth is much different. The sea ice is mobile, aggressive, powerful, and changeable in character. In the Beaufort it is divided by zones, based upon its location and identifying features.

There are three main zones. Firstly, there is the landfast ice, which as the name implies attachs to the coastal beaches of the Mackenzie Delta. This coastal ice extends out into the Sea to a depth of as much as 65 feet, and since the point at which that depth is reached varies, landfast ice can range from 10 to 25 miles from the coastline.

Secondly, there is the polar pack ice whose distance offshore can vary from year to year. This polar pack ice rotates slowly around a centre located at 80 degrees north latitude and 150 degrees longitude, and its movement is influenced by wind forces. Some years the pack ice may be 300 miles offshore, while other years it may crowd in the landfast ice only 25 miles off the coastline. The drifting can be as slow as 1½ miles a day or up to 16 miles a day in spring time.

Between the permanent pack ice and the landfast ice is the shear zone. This is where the most pronounced ice movement exists, a movement which because of Arctic winds and sea currents is prevalently from east to west. The polar pack ice rotates westerly, or clockwise as viewed looking down on the north pole. The polar pack ice is not

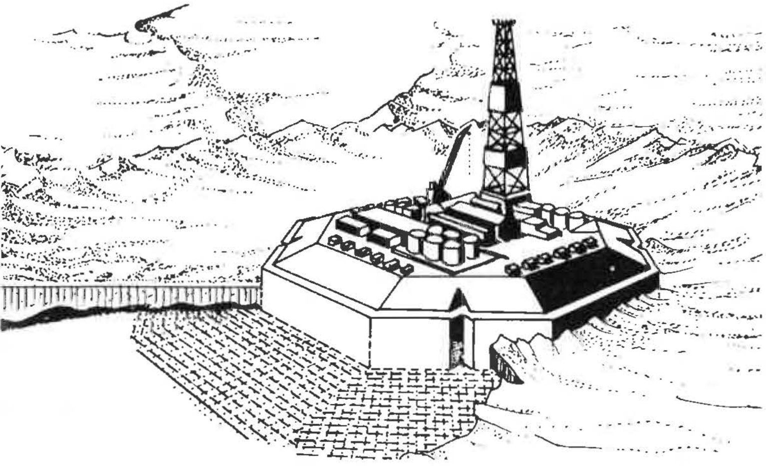
a single, homogeneous sheet of ice - it is a tumbled pile of floes and ridges, with some of the chunks measured in miles. These large chunks often break off the pack and float into the shear zone. Being so large the summer heat will never completely melt them, and extending so far unde the water they can actually scrape the sea floor in shallow depths. It is the inexorable movement of these ice floes that makes them treacherous and which makes the shear zone a difficult place to work in. But most of the drillships of the oil industry do their drilling in the shear zone.

The ice in the shear zone can exert up to 1000 pounds per square inch against the hull of a ship. It can, and has, snapped three inch thick anchor chains holding ships over a drill hole. That is why new technology quick disconnect systems were designed by the oil industry - to allow a rapid disengagement from drilling when the ice becomes overwhelming. The ice floes can also scrape the ocean floor, and may threaten pipelines if they are not buried deep enough, so research is being conducted on the scouring affects caused by these ice floes.

Naturally, the movement and intensity of ice is a vital concern to the oil industry, and aircraft ice patrols are a common defensive measure to keep track of the ice, and provide advance warning for drillships and their personnel. While landfast ice usually is about two metres thick at the coldest time of year, a moving ice islands can be up to 130 feet thick, and the keel of a large ice floe may extend as deep as 130 feet below the surface. The implacable kinetic energy of a piece of ice six miles across, and 130 feet thick, moving in the shear zone is awesome. Moreover, old ice is stronger than first year ice, and it is the kinetic energy that a multi-year ice ridge exerts which is the yardstick for designing artificial islands and tanker/icebreakers.

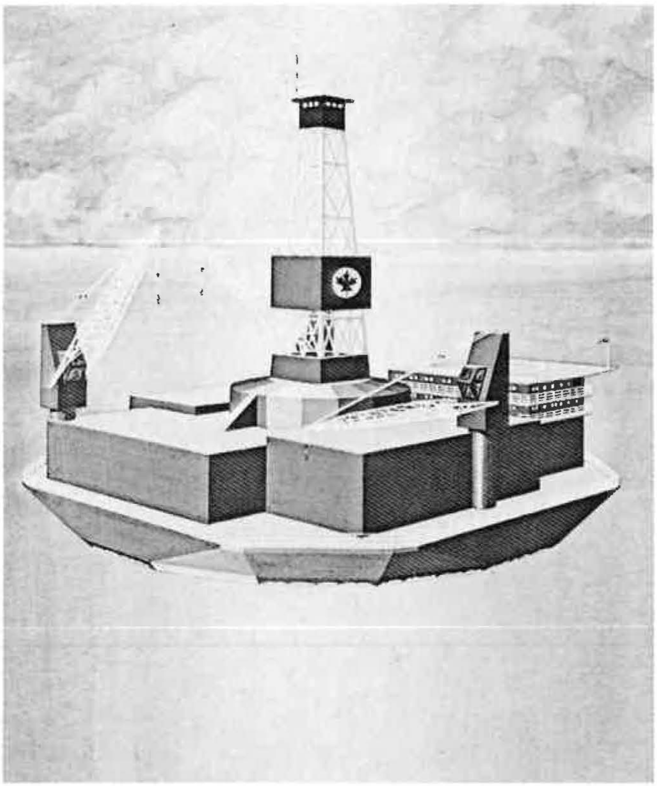
The Beaufort Sea ice has been the oil industry's most implacable and constant enemy in the search for energy. It is also the enemy about which much has been learned, and through the learning experience the companies are accomodating to and working with this ice on a year round basis.

Exploration & Production Platforms for Arctic Waters



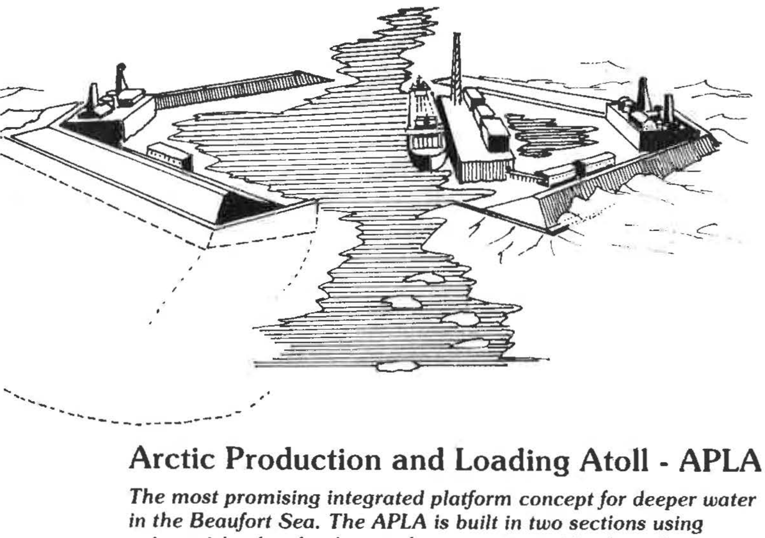
Caisson Retained Island

The first such island is presently being completed for exploration drilling in the Beaufort Sea in 1981/82, could be converted to a productioŋ island with appropriate modifications and approvals. The cassons could be made of steel or concrete and would sit on a sand berm. The caissons are back-filled with sand after placement and are designed to resist ice loads. The primary advantages of caissons are that they are not subject to significant erosion during or after construction, and require much less fill than a conventional artificial island to extend water depth capability.



Round Drill Ship

Offshore drilling operations in the Beaufort are conducted mainly from conventional ice-reinforced drillships which can operate only in moderate amounts of ice. This artist's rendering is the latest concept for a second generation drillship, which would be circular in shape, and able to withstand ice forces from any direction. Such a design could significantly extend the Beaufort drilling season from its present 110 day limit.



Arctic Production and Loading Atoll - APLA

The most promising integrated platform concept for deeper water in the Beaufort Sea. The APLA is built in two sections using caisson island technology to form a protected harbor which would be used by icebreaking tankers loading oil. Interior dimensions of the harbour are large enough to allow tankers to maneauver with the atoll. Drilling barges, production/processing barges and storage units are positioned around the interior of the atoll. There will be sufficient space on the APLA sections for four drilling rigs. Subsea pipelines would also enter the APLA from surrounding production islands for storage and shipping.

Our Back Cover is of Issungnak, the largest artificial island in the Beaufort Sea, it was built by ESSO Resources Canada Limited about 30 kilometres north of the nearest Arctic coastline in 65 feet of water. Issungnak required the dredging of five million cubic metres of sand from the sea floor. Above the water level the island is about 450 feet in diameter, and to protect it against wave action and ice shearing around its perimeters, it has 160 foot wide "sacrificial" beaches, as well as numerous slope protection devices, including yards of filter cloth and submarine netting anchored by 14,000 large, two cubic metre sand bags.